

the obscure heat-rays from copper at  $100^{\circ}$ , passing through glass, produce a deflection on the scale of  $3.25$ , whilst under the same circumstances no current is detected in the thermo-pile. The following substances are used as a screen, and the deflections produced, when the source of radiation is magnesium-wire, a standard candle, copper at  $400^{\circ}$  and copper at  $100^{\circ}$ , are tabulated:—

Rock-salt, 20 millims. thick; rock-crystal, 42 millims. thick; dark smoky talc; plate glass of various thicknesses, both white and green; a glass cell containing 8 millims. of water; a plate of alum 5 millims. thick; calc-spar, 27 millims. thick; ammonio-sulphate of copper, opaque to rays below E, ditto opaque to rays below G.

Mr. Crookes considers that these experiments show that the repulsion is not entirely due to the rays usually called heat, *i.e.* to the extremo- and ultra-red of the spectrum. Experiments have been tried with the electric and the solar spectrum formed with a quartz train, which prove the action to be exerted by the luminous and ultra-violet rays. Some numerical data have been obtained, but unfavourable weather has prevented many observations being made with the solar spectrum.

The barometric position of the neutral point dividing attraction from repulsion is next discussed. The position of this point varies with the density of the substance on which variation falls, the ratio of its mass to its surface, its radiating and conducting power for heat, the physical condition of its surface, the kind of gas filling the apparatus, the intensity of radiation, and the temperature of the surrounding atmosphere. The author is inclined to believe that the true action of radiation is repulsion at any pressure, and that the attraction observed when the rarefaction is below the neutral point is caused by some modifying circumstances connected with the surrounding gas, but not being of the nature of air-currents. The neutral point for a thin surface of pith being low, whilst that for a moderately thick piece of platinum being high, it follows that at a rarefaction intermediate between these two points pith would be repelled, while platinum was attracted by the same beam of radiation. This is proved experimentally; and an apparatus showing simultaneously attraction and repulsion by the same ray of light is described and illustrated in the paper.

Mr. Crookes concludes his paper with a discussion of the various theories which have been adduced in explanation of these phenomena. The air-current and electrical theory are considered to have been abundantly disproved. The following experiment is given to show that Prof. Osborne Reynolds's hypothesis of the movements due to evaporation and condensation at the surface will not account for all the facts of the case, and that, therefore, he has not hit upon the true explanation. A thick and strong bulb was blown at the end of a piece of very difficultly fusible green glass, specially made for steam-boiler gauges. In it was supported a thin bar of aluminium at the end of a long platinum wire. The upper end of the wire was passed through the top of the tube and well sealed in, for electrical purposes. The apparatus was sealed by fusion to the Sprengel pump, and exhaustion was kept going on for two days, until an induction-spark refused to pass across the vacuum. During this time the bulb and its contents were several times raised to a dull red heat. At the end of two days' exhaustion the tube was found to behave in the same manner as, but in a stronger degree than, it would in a less perfectly exhausted apparatus, *viz.*, it was repelled by heat of low intensity and attracted by cold. A similar experiment was next tried, only water was placed in the bulb before exhaustion. The water was then boiled away *in vacuo*, and the exhaustion continued, with frequent heating of the apparatus to dull redness, for about forty-eight hours. At the end of this time the bar of aluminium was found to behave exactly the same as the one in the former experiment, being repelled by radiation.

It is impossible to conceive that in these experiments sufficient condensable gas or vapour was present to produce the effects Prof. Osborne Reynolds ascribes to it. After the repeated heating to redness of the highest attainable exhaustion, it is impossible that sufficient vapour or gas should condense on the movable index to be instantly driven off by the warmth of the finger with recoil enough to drive backwards a heavy piece of metal.

Whilst objecting to the theories already advanced as not accounting for all the facts of the case, Mr. Crookes confesses that he is not as yet prepared with one to put in their place. He wishes to avoid giving any theory on the subject until a sufficient number of facts have been accumulated. The facts will then tell their own tale. The conditions under which they invariably occur will give the laws, and the theory will follow without much difficulty.

### THE FATAL BALLOON ASCENT

THE readers of NATURE are no doubt aware of the fatal result of the recent ascent of the balloon *Zenith*; the following authentic details at first hand will no doubt be of interest:—

CIRON (Indre), April 17.

The *Zenith* was sent up on the 15th of April in order to determine the quantity of carbonic acid contained in the atmosphere at an altitude of 24,000 feet. The "let go" was given at twenty-five minutes to twelve A.M. The captain was M. Sivel, and there were only two passengers, M. Gaston Tissandier and M. Crocé-Spinelli. The ascent took place gradually in a slight E.N.E. wind, the sky being blue but vaporous. The rate of ascent was calculated to be nine feet per second, but diminished gradually. Shortly after one o'clock the altitude obtained was 22,800, and the passengers were quite well, although feeling weak. The inhalation of oxygen produced good restorative effects when tried. Then a consultation took place, and the *Zenith* being in equilibrium, a quantity of ballast was thrown overboard. M. Tissandier then fainted, and is ignorant of what was felt by his friends.

At eighteen minutes past two he was awakened by M. Crocé-Spinelli warning him to throw over ballast as the balloon was fast descending. He obeyed mechanically, and at the same time Crocé-Spinelli threw overboard the aspirator, weighing eighty pounds. Tissandier then wrote in his book a few disconnected words, and again fell asleep for about an hour. When he awoke, the balloon was descending at a terrific rate; no more ballast was left to be thrown away, and his two friends were suffocated. Their faces had turned black, and the blood was flowing from their mouth and nose. They were evidently dead. It was a terrible situation.

The only resource was to cut the grapnel rope a little before the instant when the car should strike the ground, which Tissandier did with astonishing coolness. The wind had increased in strength, and Tissandier was obliged to tear open the balloon in order to stop it. It was caught on a hedge in a commune of Indre, called Ciron, 190 miles S.S.W. from Paris.

The tragic fate of Sivel and Spinelli is to be ascribed to the fatal resolution of accomplishing, at any price, a height of 24,000 feet, but mainly, no doubt, to the throwing out of the aspirator, which will be discovered somewhere perhaps unbroken, as it had been provided with a parachute.\*

The only instruments broken are the potash tubes for the absorption of carbonic acid. The experiment had been tried successfully; two aspirators had been used, but the tubes were not lodged in their proper case.

Careful readings were taken with the thermometer, and,

\* According to the *Times* correspondent, this and other things have been found.

although diminishing, the temperature was remarkably high :—

9,600 feet	...	...	1° Centigrade
12,000 "	...	...	0° "
13,200 "	...	...	0° "
15,420 "	...	...	-5° "
19,600 "	...	...	-8° "
22,960 "	...	...	-10° "

The temperature of the gas in the interior of the balloon was also observed by a new system. It was found to vary very little, owing to the heating power of the sun, and at 22,900 feet was found to be  $+25^{\circ}$ , showing a difference of  $-35^{\circ}$  centigrade with the temperature of the air.

This result is extremely remarkable, and was observed at several intervals, although the gas ought to suffer a diminution of temperature owing to its constant dilatation.

Although the air was clear and the sky quite blue, a number of cirrus clouds were seen on the horizon, which could not be seen from the surface of the earth.

As far as can be inferred from the ascertained facts, there was no sensible variation in the direction of the air for an immense altitude. It accounts for the unprecedented beauty of the weather and the purity of the air; it may be taken as a fair prognostic of the continuance of good weather for at least a few days.

The *aéronauts* had in their cars maximum barometers in a sealed box, in order to test the altitude in which they were travelling. These tubes, having been saved, will be tested in the laboratory of M. Hervé-Mangon.

M. Tissandier was slightly hurt in his fall. Great sympathy has been elicited for Sivel and Crocé-Spinelli, who may be said to have spent their lives in the battle-field of the air. Sivel was formerly a captain of the mercantile navy; his age was forty-two years. Crocé-Spinelli was a pupil of the *École Centrale*, and was thirty-two years of age. The former was a widower, and leaves a girl, and the second was a bachelor. A subscription is being contemplated for the fatherless child.\*

The *Zenith* is in good order, and will be put in repair. Although marred by a sad tragedy, and although the composition of the air has not been ascertained, as was contemplated, the expedition cannot be said to be devoid of results. It will serve as an incitement to further investigation in the same direction, but with greater caution.

W. DE FONVIELLE

Since the date of our correspondent's letter, it would seem from the indications shown by the uninjured barometers that the height reached was actually 14,000 metres, or eight miles. On Tuesday the bodies of Sivel and Spinelli were interred with well-deserved honours in *Père la Chaise*, many eminent scientific men being present. Subscriptions on behalf of those who were dependent on the two martyrs to science will, we believe, be received at the office of the *Courrier de l'Europe*, Tavistock Street, Covent Garden.

### NOTES

THE Royal Society during the present session have elected the following nine eminent scientific men as foreign members :— Pierre J. van Beneden, of Louvain; Joseph Louis François Bertrand, of Paris; Alfred Louis Olivier Des Cloizeaux, of Paris; Hippolyte Louis Fizeau, of Paris; Elias Magnus Fries, of Upsal; Jules Janssen, of Paris; Auguste Kekulé, of Bonn; Gustav Robert Kirchhoff, of Berlin; and C. Ludwig, of Leipsic.

\* The *Times* correspondent states that M. Sivel leaves a widow as well as a child, and that M. Spinelli was the sole support of his parents. To quote the words of the correspondent, "The scientific world will doubtless respond liberally to this appeal, for MM. Spinelli and Sivel lost their lives, not in gratifying foolhardy curiosity, but in endeavouring to penetrate the secrets of the atmosphere for the benefit of science." M. Tissandier's own account of the journey will be found in Monday's *Times*.

Also the Earl of Carnarvon, Mr. W. E. Forster, and Sir Stafford Northcote have been elected Fellows of the Society.

THE names of the fifteen candidates for the Fellowship selected by the Council of the Royal Society to be recommended for election at the meeting on June 3 are W. Archer, J. R. Bennett, D. Brandis, J. Caird, J. Casey, A. Dupré, J. Geikie, J. W. L. Glaisher, J. B. N. Hennessey, E. Klein, E. Ray Lankester, Capt. Nares, R. S. Newall, W. C. Roberts, and Major-General Scott.

THE annual meeting of French astronomers took place recently at the Ministry of Public Instruction, under the presidency of M. Leverrier. It was composed of M. Dumesnil, the director of the Enseignement Supérieur, the members of the Council of the Paris Observatory, and the directors of the Marseilles and of Toulouse Observatories. The Observatory at Algiers not having been yet reorganised was not represented, though measures are very shortly to be taken to get this done. An Observatory is to be created at Bordeaux, and another at Toulouse. It is stated, moreover, that a Physical Observatory is to be created in Paris or the vicinity, and placed under the direction of the Bureau des Longitudes. The Council of the Observatory is said to have unanimously passed a vote recommending that no one should be a member of two observatories at the same time.

GENERAL SIR EDWARD SABINE has been elected a corresponding member of the French Academy of Sciences.

THE German Anthropological Society will hold its general meeting at Munich in August next, and it is intended to arrange an exhibition of the most interesting objects of Celto-Germanic origin, found upon Bavarian ground. Bavaria possesses great treasures of this kind in its Government and private collections, and these objects are of the highest importance as regards the history and culture of the earliest periods. Men of scientific authority will superintend the exhibition, which, it is proposed, is to consist of the following seven groups :—1. Flint implements found in Bavaria, such as hammers, knives, arrows, &c. 2. Bronze weapons and ornaments of the same material, particularly swords, daggers, lances, arrow-points, sickles, and objects used for personal adornment. 3. Iron weapons, such as swords, hatchets, daggers, and knives. 4. Ornaments of amber, glass, or earthenware (beads). 5. Glass and earthenware vases. 6. Casting-moulds for Celto-Germanic weapons. 7. Coins, principally Celtic ones, the so-called "rainbow-dishes." All the objects will be well taken care of, and a guarantee is given for safe keeping and return. All expenses for carriage will be defrayed by the Society.

DR. SCHWEINFURTH has just received news from the Upper Nile, stating that Mohamed Abd-es-Samat, the Nubian ivory dealer who had rendered the German traveller most important help in pursuing his explorations in the Niam-Niam and Mom-buktu districts, was killed in December last by Niam-Niam soldiers, who had besieged and finally taken his Seriba (a sort of block-house). The assistance rendered to Dr. Schweinfurth by this ivory dealer was of the highest importance, and was acknowledged both by the German and Egyptian Governments. The history of the investigation of Inner Africa, which impartially notes down the names of all men of merit, independent of their nationality, faith, or colour, will also preserve that of Abd-es-Samat, by the side of his illustrious German friend.

THE *Kölnische Zeitung* of April 17 contains an elaborate and highly interesting account of the festival which took place at Naples a few days ago, upon the occasion of the opening of the Zoological Station. Dr. Anton Dohrn, the founder of the station, made the opening speech. After him Prof. Panceri, of Naples University, thanked Dr. Dohrn in the name of Italy for his great efforts in carrying the important work to a successful